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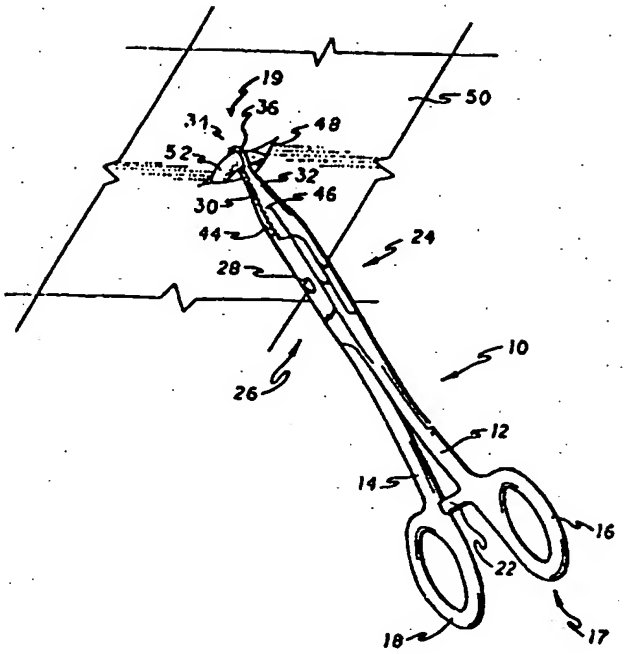
(54) **FORCEPS**

(54) **FORCEPS**



(57) La présente invention vise un forceps muni de pointes biseautées formant une boucle fermée à l'extrémité des deux parties constituant, en position fermée, le mors d'un forceps d'immobilisation, et d'une série de cannelures à la surface des deux parties du mors et se terminant à proximité de la boucle, et d'une deuxième variante ayant la forme d'un sablier lorsqu'elle est vue de profil. Ce forceps permet de réduire le glissement de tissus tubulaires ou fibreux grâce à la rive biseautée et soulevée de la boucle fermée du côté intérieur de l'ouverture. L'ouverture ayant un profil ovalisé en forme de sablier, défini par la boucle fermée

(57) A forceps having a closed loop defined by the ends of beveled grasping tips attached to a pair of jaws of locking forceps in a closed position, a series of mating serrations on the jaws ending proximate the loop, and a second embodiment thereof having an hourglass shape when viewed in profile. The forceps reduces slippage of tubular or stranded tissue by a raised bevelled ridge on the closed loop facing inward towards the aperture. The oval-shaped and hourglass profiled aperture defined by the closed loop of the second embodiment is shaped and sized to permit a surgeon to firmly grasp the vagus nerve, and the first embodiment is sized to closely grasp the vas

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de la deuxième variante de l'invention, est façonnée et dimensionnée en vue de permettre au chirurgien de saisir fermement le nerf vague tandis que la première variante de l'invention est dimensionnée de manière à permettre une immobilisation très près du canal déférent en vue de soulever ou de dégager la zone d'incision pour faciliter le reste de l'intervention. Dans la variante privilégiée de l'invention, l'ouverture formée par la plus grande partie de la boucle de la deuxième variante présente sur le plan transversal un diamètre interne de 3 mm, et sur le plan longitudinal, un diamètre interne de 4 mm. Le profil en forme de sablier permet de loger le nerf vague dans une rainure transversale de l'extrémité du forceps, ce qui justifie la constriction caractéristique du profil de sablier. Les cannelures à imbrication du mors définissent un axe longitudinal le long de l'instrument et forment une ligne continue solidement fermée derrière la boucle terminale du forceps. Les manches du forceps, dans la deuxième variante de l'invention, mesurent approximativement 11 cm de longueur, assurant ainsi la portée additionnelle nécessaire au cours des interventions chirurgicales touchant l'estomac et le bas oesophage, pratiquées à proximité du nerf vague.

deferens, to allow elevation of either up and out of the incision area, in order to facilitate the remaining procedure. The preferred aperture opening as defined by the larger loop of the second embodiment has a 3 mm transverse inner diameter and 4 mm longitudinal inner diameter. The hourglass profile allows the vagus nerve to rest in a transverse groove of the tip, defining the constriction found in the hourglass profile. The mating serrations, which form a line following the lengthwise extension of the instrument, provide a continuous, firmly closed line behind the loop and define the longitudinal axis of the forceps. The arms of the second embodiment are approximately 11 centimeters long, thereby providing additional reach necessary in surgical interventions in the lower esophagus and stomach where the vagus is present.

ABSTRACT OF THE DISCLOSURE

A forceps having a closed loop defined by the ends of beveled grasping tips attached to a pair of jaws of locking forceps in a closed position, a series of mating serrations on the jaws ending proximate the loop, and a second embodiment thereof having an hourglass shape when viewed in profile. The forceps reduces slippage of tubular or stranded tissue by a raised bevelled ridge on the closed loop facing inward towards the aperture. The oval-shaped and hourglass profiled aperture defined by the closed loop of the second embodiment is shaped and sized to permit a surgeon to firmly grasp the vagus nerve, and the first embodiment is sized to closely grasp the vas deferens, to allow elevation of either up and out of the incision area, in order to facilitate the remaining procedure. The preferred aperture opening as defined by the larger loop of the second embodiment has a 3 mm transverse inner diameter and 4 mm longitudinal inner diameter. The hourglass profile allows the vagus nerve to rest in a transverse groove of the tip, defining the constriction found in the hourglass profile. The mating serrations, which form a line following the lengthwise extension of the instrument, provide a continuous, firmly closed line behind the loop and define the longitudinal axis of the forceps. The arms of the second embodiment are approximately 11 centimeters long, thereby providing additional reach necessary in surgical interventions in the lower esophagus and stomach where the vagus is present.

FORCEPS

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates generally to surgical implements for gripping tissue, and more particularly to alternative embodiments of forceps used to grasp the vas deferens of the scrotum and vagus nerve while conducting surgical interventions in the lower esophagus or stomach.

2. DESCRIPTION OF RELATED ART

Voluntary surgical contraception, also called contraceptive sterilization, has become the most widely used method of family planning in the world. It is also one of the safest and most economical contraceptive methods. The health benefits of contraceptive sterilization are especially evident in developing countries where temporary contraceptive methods may be periodically in short supply or used ineffectively, and where unwanted pregnancies carry a high risk of maternal death. Contraceptive sterilization may be performed on either the female (tubal ligation), or the male (vasectomy). Although both procedures are equally effective as contraceptive methods, vasectomy is simpler, safer, and less expensive than tubal ligation.

Vasectomies can be accomplished by cutting or clipping the vas deferens. Because of the relatively high failure rate of the clipping method, cutting is preferred. In the cutting method, a forceps is used during the vasectomy procedure to grasp and elevate the vas deferens, the duct which transports sperm and semen from the testicles to the penis. The vas deferens is elevated and exposed so that it may be cut

and ligated, thus completely preventing the flow of sperm in the vasectomized male. In a standard vasectomy, the vas deferens is isolated, the grasping tips of forceps are clamped behind it, and the duct is elevated. Once having elevated the vas deferens, the surgeon rotates it, thus exposing its surrounding sheath, which is then dissected to uncover the duct.

A commonly used instrument in performing in performing surgical interventions is a standard forceps, such as Allis forceps. The standard forceps comprises a scissor-like construction that includes a locking mechanism for the two arms at the handle end. The grasping tips, at the ends of the arms opposite the handles, have mating sawtooth extensions, which meet in a line perpendicular to the lengthwise extension of the instrument and are used to clamp onto tissue.

Because of the large, flattened area defined by the tips of standard forceps, additional tissue is often grasped during a surgical operation and elevated along with the target tissue, such as the vas deferens or vagus nerve, to be grasped. For example, the vagus nerve, like many other nerves, lies in close proximity to vascular tissue such as veins and arteries, and is, along with such other tissues, cloaked in mesenteric tissue. Moreover, a nerve, although having moderate resilience to stretching thereby allowing an instrument to be placed loosely beneath the nerve to retract it from a surgical site, is particularly vulnerable to crushing, the consequence of which may include faulty neurological transmission due to an interruption of electrical conduction caused by irreparably crushing of cells. Because the vagus nerve has a large diameter, exceeding 4 mm in places, to pull it up and out of an incision area with the larger, flattened areas of the tips of the closed jaws of the a standard forceps would likely cause crushing,

and at best pinching as a result of the nerve bending over the edged surface of the jaws. Thus, the large ends and clamping structure defined by the standard forceps is particulary unsuited for use to grasp and retract the vagus nerve.

Moreover, particularly in the case of the vas deferens, due to the open ends of the grasping tips, tissue often slips out of the grasp of the instrument when the nerve is lifted clear. The large end structure defined by the standard forceps frequently permits the vas deferens to escape the surgeon's grasp as he pulls it up and out of the incision. Finally, due to the large open ends of the grasping tips, the vas deferens often slips out of the grasp of the instrument when the duct is rotated to expose the surrounding sheath. In each case, the surgeon is required to recapture the duct, and recommence this part of the procedure. Such imprecision and slippage renders the procedure longer, and more difficult to conduct than if a forceps with a design more specific to the procedure were used. In each case, the surgeon is required to recapture the tissue, and recommence this part of the procedure. Such imprecision and slippage renders the procedure longer, and more difficult to conduct than if a forceps with a design more specific to the procedure were used.

Another common instrument known is the rod clamp used with a threaded rod in orthopedic surgery. The clamp has a blunt, widened tip, defining an aperture for passage and clamping of the rod. Whereas the aperture may allow passage of any tubular item, the blunt, wide tip and short jaws prevent the rod clamp from use for fine manipulations in a wound site, such as finding a nerve in an already occluded area. The short, wide, blunt jaws would act to block the view of the wound site. Moreover, because the end of the jaws are very near the pivot stud joining the two arms of

the clamp to allow a scissoring action of the clamp, the arms must be widely spread apart for open the jaws to open sufficiently at the opposite end to accept the vagus nerve. This would require a surgeon to have a very large hand span in order to operate with difficulty at best.

Several attempts have been made to overcome the problems associated with the use of standard forceps in procedures requiring manipulation of stranded or tubular tissues. U.S. Patent No. 2,397,823, issued to Carl W. Walter, on April 2, 1946, discloses a forceps intended to be capable of grasping a wide variety of objects. This forceps has a elongated "pistol-grip" handle. It is oriented at an angle of at least 45 degrees relative to a gripping portion of the device. The forceps of Manuel V. Santos shown in U.S. Pat. No. 3,828,791 issued August, 13, 1974 utilizes a similar functional design. Consequently, minute manipulations of tissue during a surgical procedure would be cumbersome at best, and dangerous at worst.

Moreover, the Walter forceps is shown to have serrations on the very tip. Such serrations, while providing additional gripping friction, would necessarily cause destruction of surrounding tissue. Also, the presence of these serrations clearly indicate that this forceps has a clamping hole substantially recessed from the end of the device, in stark contrast with applicant's own invention. Use of such a device in a retraction of the vagus nerve or vas deferens would require a larger incision than necessary to pass the device into the wound site sufficiently far for the clamping hole to engage the vas deferens (requiring an extraordinarily large incision in the scrotum for insertion of the device, leading to increased likelihood of infection), or, similarly, the vagus nerve. Moreover, it would cause tissue damage when the device is closed and clamped

around the nerve. It would also make the lifting of the vagus nerve and, during the vasectomy procedure, lifting and turning of the vas deferens impossible without substantial destruction of surrounding, additional tissue caught in the large extension of the forceps' tips beyond the clamping hole, in turn resulting in additional, unwarranted procedure length, trauma, and danger.

Both the Santos and Walters devices fail to have a beveled rim around the edge of the hole nearer its grasping end to provide effective gripping for lifting stranded tissue such as the vagus nerve. Instead, the Walters device has "arcs of different curvature" disposed around the rims of recesses in the jaws, which are described as including an "almost blade-like inner edge." Such bladed arcs would tend to cut tissue held, making holding of tissue impractical and dangerous. In fact, the forceps is intended for use with objects other than tissue, such as needles and swabs. Importantly, the literature describing the use of this device does not even mention its use for vagus retraction and lifting or vasectomies.

U.S. Patent No. 2,642,871, issued to Joseph Theurig, on June 23, 1953, discloses a forceps suitable for grasping tubular objects, such as syringes. The forceps has a clamping aperture described and depicted as comprising "transverse inverted obtuse angular meeting faces." The difficulty concomitant of using such a device in lifting the vagus nerve and vas deferens is substantial. Because the aperture is not curved to the shape of a tubular or stranded tissue, such as the vas deferens or vagus nerve, the tissue would tend to both slide laterally and rotate within the aperture, if not be pinched during full closure with the tips contacting one another. Such sliding during vasectomies would make performance of the procedure impossible because the appropriate cutting

and knotting of the duct would be unfeasible. Making the device smaller, so that the device would immovably hold the vas deferens or vagus, would result in failure of the device to close completely, as shown in Fig. 4 of the Theurig patent. Without complete closure, the device would tend to allow undesired release of the vas deferens and vagus during required lifting or rotation. The Theurig forceps also lacks a beveled rim around the edge of the hole nearer its grasping end to provide effective gripping of tubular tissue. Notably, the literature referring to the use of this device does not even mention use for retracting the vagus nerve or for vasectomies.

U.S. Patent No. 5,067,956, issued to Jeffrey J. Sandhaus, on November 26, 1991, demonstrates a complicated apparatus intended to be used in procedures for implanting locking clips for clamping and occluding tubular vessels, such as the vas deferens during a vasectomy. In addition to the ancillary concerns about cost, ease of construction and maintenance, this device has several practical shortcomings in regard to use and teaching in relation to vasectomy forceps and vasectomy procedures. One problem is that it relies on clamping of the vas deferens, rather than cutting it; consequently, the desired sterilization cannot be completely ensured by the use of this device. Another problem is that its complicated operation requires special training for use, and requires additional pre-surgical preparation time. Whereas the device includes a curved clamping hole appropriate for immovably holding a tublar vessel with the tips contacting one another, the clamping hole is relatively far removed (in comparison with applicant's own invention) from the end of the apparatus, as shown in Fig. 45 of the Sandhaus patent. Use of such a device in a vasectomy or vagus lifting procedure would cause tissue damage while the device

is passed sufficiently far into the wound site for the clamping hole to engage the vas deferens or vagus; cause tissue damage when the device is closed and clamped around the vagus nerve; and, make the procedure's lifting of the vagus impossible without substantial destruction of surrounding tissue, because of additional tissue caught in the large extension of the forceps' tips beyond the clamping hole. The Sandaus forceps also fails to provide a beveled rim around the edge of the hole nearer its grasping end to provide effective grasping during lifting or rotation of a tubular tissue to prevent lateral slippage of the instrument along the tubular tissue.

British Patent No. 2,227,200, issued to Malcolm Charles Holbrook, on July 25, 1990, discloses a forceps used for holding a catheter or organ duct during the course of a surgical procedure. This forceps has a three-millimeter clamping hole centered five millimeters from the end of the forceps, a relatively large distance (many times as large as the applicant's own invention) that makes the device unusable for the vagus retracting procedure. This forceps was designed for its invisibility to X-rays used during a surgical procedure, and not for use in vagus retractions.

The Holbrook forceps also lacks a beveled rim around the edge of the hole nearer its grasping end to provide effective gripping a vagus nerve. The large end design of the Holbrook patent has a clasping, rather than grasping function, and is unsuitable for use with nerve tissue due to the risk of crushing.

Other inventions have similar disadvantages. UK Patent Application No. 2 210 574 to James Richard Smith describes a forceps with triangular head, including a bridge defining an aperture for gripping a suture needle. None of the devices shown therein can grasp a vagus nerve without clamping down upon it,

causing crushing. This disadvantage is likewise true of the surgical forceps with notches for accommodating suture needles as shown in U.S. Pat. No. 4,226,241 issued October 7, 1980 to William E. Walker, Jr. USSR Patent No. 145,976 shows a pair of forceps, having serated teeth provided along a substantial portion of the tip before an aperture is provided. Like the previously mentioned devices, the serated tip increases the risk of crushing and increased trauma due to insertion of the tip into surrounding tissue. USSR Patent No. 1321409 shows a pair of forceps, having semi-circular jaws with intermittant sets of serated teeth. USSR Patent No. 219095 shows a pair of forceps, having open-ended tipped jaws moulded to the same shape as a prosthesis for the long branch of the anvil in the ear; the open-ended tips are unsuitable for retracting a tubular tissue, allowing it to slip om the open-ends.

Finally, European Patent Application by applicant Fritz Lolagne published January 25, 1995, contemplates forceps generally sized to closely conform to the cross-sectional shape of the vas deferens and vagus nerve, providing preferred diameters of the enclosing aperture at the tip of the forceps to be 0.40 centimeters in length and 0.30 centimeters in width. The application fails to disclose the crested ridge or the hourglass profile of the present invention.

None of the above inventions and patents, taken either singularly or in combination, is seen to describe the instant invention as claimed. Thus, a forceps solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

The forceps of the present invention includes a first embodiment and modified second embodiment to

resolve the problems inherent in the prior art. Each embodiment includes a small end structure, comprising an oval-shaped, closed loop, the second embodiment further having an hourglass shape when viewed in profile. The closed loop of both is defined by the ends of beveled grasping tips attached to a pair of jaws of locking forceps in a closed position, a series of mating serrations on the jaws ending proximate the loop.

In the first embodiment, the preferred aperture opening is defined by the loop having a 2.5 mm transverse inner diameter and 4 mm longitudinal inner diameter. The shape and size of this closed loop permits the surgeon to firmly grasp the vas deferens and surrounding sheath, to elevate it up and out of the incision, and to rotate it all in one movement, thus exposing the surrounding sheath in order to facilitate its dissection. Once the duct is thus exposed by the invention, it can be easily cut and ligated. The mating serrations, which form a line following the lengthwise extension of the instrument, provide a continuous, firmly closed line behind the loop. As compared to a vasectomy as performed with the standard forceps design, the surgeon using the present invention need not create an excessively large scrotal incision to grasp the vas deferens, elevate it out of the incision, and rotate it to expose the outside sheath for dissection. Moreover, the standard forceps cause additional tissue to be grasped and damaged, and the vas deferens slips with such frequency that effective cutting and ligation of the vas deferens is difficult and time-consuming. In contrast, the minute, beveled, curved loop of the present invention allows for a smaller incision with more accurate grasping, reduces slippage during this part of the procedure, and assures that no tissue other than the vas deferens is grasped. In fact, the

applicant has found in his own medical practice that the present forceps are easier, faster, safer and generally much preferable to use in the course of performing vasectomies, as compared to use of standard forceps.

In the second embodiment, the loop is approximately 0.60 centimeters in longitudinal outer diameter (from distalmost tip to first serration) and 0.40 centimeters in transverse outer diameter (from outside surface to outside surface). The forceps also reduces slippage of the vagus by a raised bevelled ridge on the closed loop facing inward towards the aperture. The oval-shaped and hourglass profiled aperture defined by the closed loop is shaped and sized to permit a surgeon to firmly grasp the vagus nerve, and to elevate it up and out of the incision area, in order to facilitate the remaining procedure. The preferred aperture opening is defined by the loop having a 3 mm transverse inner diameter and 4 mm longitudinal inner diameter. The hourglass profile allows the vagus nerve to rest in a transverse groove of the tip, defining the constriction found in the hourglass profile. The mating serrations, which form a line following the lengthwise extension of the instrument, provide a continuous, firmly closed line behind the loop and define the longitudinal axis of the forceps. The arms of the forceps are approximately 11 centimeters long, thereby providing additional reach necessary in surgical interventions in the lower esophagus and stomach where the vagus resides.

Thus, the present invention provides numerous advantages over the standard forceps design used in conducting vasectomies and vagus nerve retractions, including but not limited to:

(1) reducing the risk of slippage of the vas deferens or vagus nerve due to the oval-shaped

grasping opening, thereby reducing the time needed to conduct the procedure so the operation can be accomplished more safely and with less discomfort to the patient;

(2) a smaller incision than that necessary with the standard forceps due to a decreased tip size, thereby reducing risk of infection or hemorrhage following a vasectomy or vagus resection procedure, respectively, and providing an added cosmetic benefit to the patient in the case of a vasectomy; and.

(3) specifically with regard to the second embodiment, minimizing the risk of pinching the vagus nerve due to the properly dimensioned opening and the hourglass profile, which allows the nerve to lie across the jaws on a more gentle arc.

Specifically with regard to the first embodiment, a vasectomy can be accomplished using the first embodiment in approximately six to eight minutes, as compared with more than fifteen to twenty minutes using the standard forceps design. This reduction is achieved without changing the technique used for the procedure. Since most vasectomies are performed using local anesthesia, a reduction in the time necessary to conduct the procedure means the operation can be accomplished more safely and with less discomfort to the patient.

Accordingly, it is a principal object of the invention to reduce the risk of slippage of the vagus during retraction and vas deferens during vasectomies by providing an oval-shaped grasping aperture sized to the diameter of the vagus nerve and vas deferens, which allows a user to grasp and lift the vagus nerve or vas deferens more easily and securely than does the standard design.

It is another object of the invention to reduce the time needed to conduct a procedure by reducing the lost time due to slippage of a tubular or stranded

tissue during a procedure, as compared to using the standard forceps design, by providing a surgical clamp having a closed ended loop.

It is a further object of the invention to reduce damage to surrounding tissue by having a very short tip which encloses the tubular or stranded tissue without unduly grasping or otherwise disturbing surrounding connective and other tissue.

Still another object of the invention is to provide a tip which allows the vagus nerve to rest in a groove during lifting of the vagus nerve.

An additional object of the invention is to provide a forceps suited for excellent characteristics for use in operations involving the vagus nerve by virtue of added length to the forceps handle.

A still further object of the invention to provide a forceps having a grasping opening, as opposed to a clamping opening, of a size and shape which prevents crushing of the vagus nerve during interventions in the lower esophagus or stomach.

Still another object of the invention is to allow for a smaller incision to be made during a vasectomy procedure than that necessary with standard forceps by providing a smaller end structure, thereby leading to reduced risk of infection following the procedure and producing less cosmetic damage.

It is an object of the invention to provide improved elements and arrangements thereof in an apparatus for the purposes described which is inexpensive, dependable and fully effective in accomplishing its intended purposes.

These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an enviromental, perspective view of the invention showing the forceps of the first embodiment.

Fig. 2 is a plan view of the first embodiment of the forceps of the present invention, in a closed position, featuring the oval-shaped opening of the grasping tip and showing a bevelled ridge as a greatly enlarged feature for clarity of illustration.

Fig. 3 is a plan view of the first embodiment of the forceps of the present invention, in a pre-grasping or open position.

Fig. 4 is an enlarged, close-up view of the grasping tips of the first embodiment, depicting the thin, pincer-like grasping tips and the beveled bottom portion of the clamping loop.

Fig. 5 is a cross-sectional view of the grasping end of the first embodiment.

Fig. 6 is an environmental, perspective view of a second embodiment of the forceps according to the present invention.

Fig. 7A is an top plan view of the second embodiment of the forceps in a closed state according to the present invention.

Fig. 7B is a side view of a partial profile of the forceps according to the second embodiment of the present invention, featuring the hourglass profile of the closed tip.

Fig. 8 is a top plan view of the second embodiment of the forceps in an open state according to the present invention.

Fig. 9 is a greatly enlarged, perspective view of a detail of the second embodiment of the forceps according to the present invention, featuring the open tip.

Fig. 10 is a side view, partially fragmented of the second embodiment of the forceps according to the present invention, featuring the hourglass profile of the grasping tip.

Fig. 11 is a top cross-sectional view of the second embodiment of the forceps according to the present invention, environmentally representing the vagus nerve enclosed in the grasping tips, as drawn along line 11--11 of Fig. 7A.

Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a surgical instrument in two embodiments for grasping, elevating, and retracting stranded or tubular tissue, particularly the vas deferens and the vagus nerve.

Describing first the first embodiment, the forceps 10 includes arms 12, 14, each having handle sections 16, 18 at a first end 17. The handle sections 16, 18 have sawtooth extensions 20, 22 projecting inward from the handle sections 16, 18. The sawtooth extensions 20, 22 engage one another when the forceps 10 is in a closed position, as shown in Fig. 2.

The arms 12, 14 also have pivoting sections 24, 26 next to the handle sections 16, 18. Along these pivoting sections 24, 26, the arms 12, 14 cross one another and are connected at their crossing by a cross-over stud 28, as shown in Fig. 1. The preferred length between stud 28 and first end 17 is approximately 10.5 centimeters.

The arms 12, 14 additionally have grasping sections 30, 32 at a second end 19. The length from stud 28 to second end 19 is approximately 3 centimeters. The grasping sections 30, 32 comprise grasping tips 34,

which define and semi-enclose open, grasping regions 38, 40. As may be seen, from Fig. 3 particularly, the juxtaposition of such grasping regions 38, 40 upon placement of the forceps 10 in a closed orientation, forms an oval opening 42, somewhat elongated along an axis parallel to a long axis of the forceps. Sample dimensions for the opening are 0.25 centimeters in width and 0.40 centimeters in length. The grasping sections 30, 32 also have mating serrations 44, 46, which lie farther from the second end than the grasping tips 34, 36 and grasping regions 38, 40, and immediately adjacent to said tips 34, 36 and said regions 38, 40.

The grasping tips 34, 36 have a v-shape formed by inverted v-shaped beveled surfaces extending away from arms 12, 14 into oval opening 42. The v-shaped surfaces or ridges 44a, 46a (best viewed in Fig. 4) are disposed circumferentially around inner edges or facing surfaces of the grasping tips 34, 36. The v-shaped surfaces 44a, 46a may extend along the entire facing surfaces of grasping tips 34, 36 or may extend only partially along the facing surfaces, preferably along the lower half of the facing surfaces closer to the first end 17. The v-shaped ridges project at a greater height at an end of the grasping tips 34, 36 farther from the second end 19 than at an end of the grasping tips 34, 36 nearer to the second end 19. The v-shaped ridges 44a, 46a culminate in crest tips. The crest tips may be sharp or may be rounded, preferably with a radius of curvature of about 500 micrometers. The v-shaped surfaces faciliate the grasping function of the forceps 10 by slightly circumferentially depressing the vas deferens and preventing lateral sliding of the forceps.

In use of the forceps during a vasectomy procedure, a user first creates an incision 48 in the scrotum 50. Because of the compact and efficient shape of the

present forceps 10, such an incision 48 can be smaller than an incision (not shown) provided using forceps of the prior art (not shown). More specifically, the grasping tips 34, 36 are extraordinarily narrow, as viewed from any perspective, Figs. 1 and 5. Additionally, the grasping regions 38, 40 are positioned at a most extreme portion of the second end 19, so that there is essentially no distance between the grasping regions 38, 40 and the most extreme portion of the second end 19, as shown in Fig. 3. As will be appreciated, limitations on the character of submitted drawings make it necessary to depict even very thin objects with with some distance between edges; however, it must be understood that the locations of the grasping regions 38, 40 are as close to the most extreme portion of the second end 19 as is physically and practically possible. This positioning of the grasping regions 38, 40 comprises a crux of the innovation of this invention, insofar as this positioning enables the user to grasp tubular tissue such as the vas deferens 52 without contacting or grasping tissue beyond the location of the tubular tissue sought to be grasped, and without making a large incision.

With more particularity, the dimensions of the generally oval shaped opening 42 are about 0.40 centimeters in length and 0.25 centimeters in width, and the distance between the most extreme portion of the second end 19 of arms 12, 14, and the end of the opening nearest said tip is less than 1 millimeter. These dimensions are depicted approximately in Figs. 2 and 3, within the constraints of limitations on submitted drawings. It may be seen particularly from Fig. 3, that the small overall grasping sections' 30, 32 size, the closed loop 42, and the proximity of this loop 42 to the distal extremity of the forcep arms 12, 14 that enables the use and advantages of the present

forceps 10. Moreover, the small size and extreme location of the grasping sections 30, 32 and the closed loop 42, as well as the proximity of this end loop to the distal extremity of the forcep arms 12, 14, enable the user to efficiently tip up or rotate the vas deferens 52 to be out of the incision 48 during a vasectomy so that its covering sheath (not shown) can be dissected. The overall procedure, as previously described herein, is thereby enabled with a greatly shortened time for the surgery, and with more precision in lifting, rotating and initially locating the vas deferens. In other words, the shape and size of the grasping sections 30, 32 permit the user to firmly grasp the vas deferens 52, to lift it up and out of the incision 48, and to rotate it all in one motion, thus exposing the surrounding sheath for dissection. Once the duct 52 is exposed, it can be easily cut and ligated. Significantly, the risk of slippage of the vas deferens 52, when it is rotated during the vasectomy procedure, is greatly reduced. The mating serrations, forming a line matching the lengthwise extension of the instrument, closes firmly behind the opening 10a, 12a.

A method of use of the apparatus 10 would include the steps of: lowering grasping sections 22 of arms 12, 14 of a forceps instrument 10 according to the invention into the incision 48; causing grasping regions 38, 40 located at an extreme end of the forceps 10 to surround and encompass the vas deferens 52; closing the instrument 10, with serrations 44, 46 in mating position and engaging sawtooth projections together so the device 10 is locked closed, as shown in Fig. 2; lifting the vas deferens 52 out of the incision 48; and rotating it to facilitate dissection of the surrounding sheath (not depicted). Subsequently, the vas deferens is severed and resulting cut ends (not shown) are ligated closed.

Alternately, the ligations (not shown) may be placed first, and the vas deferens 52 cut between the ligations. The forceps 10 is released, and standard surgical procedures follow.

Turning now to the description of the second embodiment and referring to Figures 6-11, forceps 110 includes structural elements common to both embodiments, namely arms 112, 114, each having handle sections 116, 118 at a first end 117. The handle sections 116, 118 have sawtooth extensions 120, 122 projecting inward from the handle sections 116, 118. The sawtooth extensions 120, 122 engage one another when the forceps 110 is in a closed position, as shown in Fig. 7A.

The arms 112, 114 also have pivoting sections 124, 126 next to the handle sections 116, 118. Along these pivoting sections 124, 126, the arms 112, 114 cross one another and are connected at their crossing by a cross-over stud 128, as shown in Fig. 6. The preferred length between stud 128 and first end 117 is approximately 14.5 centimeters. The length from stud 128 to a second end 119 is approximately 8 centimeters. The arms 112,114 of the forceps 110 approximate eleven centimeters from stud 128. An overall length of the forceps 110 of approximately 22.5 centimeters is thereby attained, providing additional reach necessary in surgical interventions in the lower esophagus and stomach where the vagus is present.

The arms 112, 114 additionally have grasping sections 130, 132 at a second end 119. These grasping sections 130, 132 comprise grasping tips 134, 136 which define and semi-enclose open, grasping regions 138, 140. As may be seen, from Fig. 7A particularly, the juxtaposition of such grasping regions 138, 140 upon placement of the forceps 110 in a closed orientation, forms a substantially oval opening 142,

somewhat elongated along an axis parallel to a long axis of the forceps. Sample dimensions for the opening are 0.3 centimeters in width and 0.4 centimeters in length (or 3 mm transverse inner diameter and 4 mm longitudinal inner diameter).

In profile, grasping tips 134,136 are both formed as identical hourglass configurations, which provide opposing, transverse grooves 137,139, as most clearly seen in Fig 7B. As shown in Fig. 6, the hourglass profile allows the vagus nerve V to rest in a transverse groove 137 of a grasping tip 134, providing a seat mimimizing pinching and crushing of the nerve when stretched during retraction. As can be appreciated from Fig. 11, the vagus nerve V is shown closely entrapped by the grasping tips 134,136, and grooves 137,139 of tip 136 permit a gradual bend in the vagus nerve without pinching, unlike a cylindrical channel formed by an edge over which the vagus nerve could be pinched. As a further result of the hourglass configuration, the leading edges 149,151 (Figs. 8 and 9) appear as bar-like edges, having a nominal width and a length substantially the same as the thickness of the instrument. The nominal width minimizes the surface area capable of inadvertantly grasping surrounding tissue but still allows edges 49,51 to completely enclose the vagus nerve.

The grasping sections 130, 132 also have mating serrations 144, 146, which lie farther from the second end than the grasping tips 134,136 and grasping regions 138,140, and immediately adjacent to said tips 134, 136 and said regions 138, 140. These serrations 144, 146 faciliate the grasping function of the forceps 110 by forming a line following the lengthwise extension of the instrument as shown in Fig 6 and 7A, to provide a continuous, firmly closed line behind the grasping tips 134,136, which line defines in part the longitudinal axis of the forceps 110.

The grasping tips 134,136 also have a v-shape formed by inverted v-shaped beveled surfaces extending away from arms 112, 114 into oval opening 142. The v-shaped surfaces or ridges 144a, 146a (best viewed in Fig. 9) are disposed circumferentially around inner edges or facing surfaces of the grasping tips 134,136. The v-shaped surfaces 144a, 146a may extend along the entire facing surfaces of grasping tips 134,136 or may extend only partially along the facing surfaces, preferably along the lower half of the facing surfaces closer to the first end 117. The v-shaped ridges project at a greater height at an end of the grasping tips 134,136 farther from the second end 119 than at an end of the grasping tips 134, 136 nearer to the second end 119. The v-shaped ridges 144a, 146a culminate in crest tips. The crest tips may be sharp or may be rounded, preferably with a radius of curvature of about 500 micrometers. Again referring to Fig. 11, the v-shaped surfaces facilitate the grasping function of the forceps 110 by slightly circumferentially depressing the vagus nerve without crushing, and thereby preventing lateral sliding of the forceps.

Because of the compact and efficient shape of the present forceps 110, an incision 148 of surrounding connective tissue can be smaller than an incision (not shown) provided using forceps of the prior art (not shown). More specifically, the grasping tips 134,136 are extraordinarily narrow. Additionally, the grasping regions 138, 140 are positioned at a most extreme portion of the second end 119, so that there is essentially no distance between the grasping regions 138, 140 and the most extreme portion of the second end 119, as exemplified in Fig. 9 by the narrow width of the leading edge 49. As will be appreciated, limitations on the character of submitted drawings make it necessary to depict even very thin objects

with with some distance between edges; however, it must be understood that the locations of the grasping regions 38, 40 are as close to the most extreme portion of the second end 19 as is physically and practically possible. This positioning of the grasping regions 38, 40 comprises a crux of the innovation of this invention, insofar as this positioning enables the user to grasp stranded or tubular tissue such as the vagus nerve V without contacting or grasping tissue beyond the location of the tubular tissue sought to be grasped, and without making a large incision.

With more particularity, the dimensions of the generally oval shaped opening 142 are about 0.40 centimeters in length and 0.30 centimeters in width, and the distance between the most extreme portion of the second end 119 of arms 112, 114, and the end of the opening nearest the tip is less than 1 millimeter. These dimensions are depicted approximately in Figs. 7A and 8, within the constraints of limitations on submitted drawings. It may be seen particularly from Fig. 7A, that the size of the elongated overall grasping sections 130,132, the closed loop or oval opening 142, and the proximity of this loop 142 to the distal extremity of the forcep arms 112, 114 enables the use and advantages of the present forceps 110 with the procedures retracting the vagus nerve. Moreover, the small size and extreme location of the grasping sections 130, 132 and the closed loop 142, as well as the proximity of this end loop to the distal extremity of the forcep arms 112, 114, enable the user to efficiently tip up or lift the vagus nerve V to be out of the incision 148, i.e. retraction. The overall procedure is thereby enabled with a greatly shortened time for the surgery, and with more precision in lifting and initially locating the vagus nerve. In other words, the shape and size of the grasping

sections 130, 132 permit the user to firmly grasp the vagus nerve V, to lift it up and out of the incision 148, and thus expose the surrounding area for further manipulation. Significantly, the risk of slippage of the vagus V, when it is held by the forceps 110 is greatly reduced. The mating serrations, forming a line matching the lengthwise extension of the instrument, closes firmly behind the opening.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A forceps for use in grasping, elevating, and rotating tubular tissue of the human body, comprising:

a pair of elongated forceps arms, said arms defining an intersection;

a stud at said intersection;

said arms pivoting about said stud and defining a pair of facing openings for grasping at a first end of each of said arms;

said facing openings defining a closed, generally oval-shaped opening, said opening being less than 1 millimeter from the extremity of said arms at said first end;

a handle at a second end of each of said arms;

a length from said stud to said second end being at least 10.5 centimeters; and,

a length from said stud to said extremity of said arms at said first end being at least 3 centimeters.

2. A forceps comprising:

a pair of elongated forceps arms, one elongated arm having an aperture therethrough, a first end at least 10.5 centimeters from the aperture, and a second end at least 3 centimeters from the aperture;

a stud disposed wholly within the aperture of said one elongated arm, said stud pivotally connecting said pair of elongated arms;

a handle formed at the first end of each elongated arm; and,

a grasping section formed at the second end of each elongated arm, each said grasping section terminating in a grasping tip, each said grasping tips together positioned opposite one another and defining an oval opening when said forceps are closed, said opening being not more than 0.40 centimeters in diameter in a first direction parallel with said elongated arms and

not more than 0.30 centimeters in diameter in a direction substantially perpendicular in two axes to said first direction, said opening disposed within one millimeter of the second end of said elongated arms, each said grasping tip having a v-shaped ridge, each said v-shaped ridge together being diametrically opposed and disposed within said oval opening, and said grasping section also including a serrated portion adjacent to said grasping tip.

3. The forceps according to claim 2, wherein said arms from said rod to said handle are at least 10 centimeters.

4. The forceps according to claim 2 wherein said first end is approximately 14.5 centimeters from said aperture.

5. The forceps according to claim 2, wherein said arms from said rod to said handle are approximately 11 centimeters in length.

6. The forceps according to claim 2 wherein said v-shaped grasping tips terminate in a sharp edge.

7. The forceps according to claim 2 wherein said v-shaped grasping tips terminate in a rounded edge having a radius of curvature of about 500 micrometers.

8. The forceps according to claim 2 wherein each said v-shaped grasping tip includes a groove transverse to the direction of said elongated arms, each said groove aligning coextensively with an opposing groove on the other of said tips.

9. The forceps according to claim 8 wherein said grasping tips have opposing outer faces and a second

groove is provided in a parallel plane and on each said opposing outer face of each said grasping tip .

10. A forceps comprising:

a pair of elongated forceps arms, one elongated arm having an aperture therethrough, a first end at least 10.5 centimeters from the aperture, and a second end at least 3 centimeters from the aperture;

a stud disposed wholly within the aperture of said one elongated arm, said stud pivotally connecting said pair of elongated arms;

a handle formed at the first end of each elongated arm; and,

a grasping section formed at the second end of each elongated arm, each said grasping section terminating in a v-shaped grasping tip having opposing faces, each said tip together defining an oval opening when said forceps are closed, said opening being not more than 0.40 centimeters in diameter in a direction parallel with said elongated arms and not more than 0.30 centimeters in diameter in a direction perpendicular to said elongated arms, said opening disposed within one millimeter of the second end of said elongated arms, and said grasping section also including a serrated portion adjacent to said grasping tip; said tip further defining a groove transverse to the direction of said elongated arms and provided on both opposing faces of each said grasping tip, each said groove aligning coextensively with an opposing groove on the other of said tips.

11. A forceps comprising:

a pair of elongated forceps arms, each elongated arm having an aperture therethrough, a first end at least 10.5 centimeters from the aperture, and a second end approximately 3 centimeters from the aperture;

a stud disposed wholly within the apertures of each elongated arm, said stud pivotally connecting said pair of elongated arms;

a handle formed at the first end of each elongated arm; and

a grasping section formed at the second end of each elongated arm, each said grasping section terminating in a v-shaped grasping tip, each said tip together defining an oval opening when said forceps are closed, said opening being not more than 0.40 centimeters in diameter in a direction parallel with said elongated arms and not more than 0.25 centimeters in diameter in a direction perpendicular to said elongated arms, said opening disposed within one millimeter of the second end of said elongated arms, and said grasping section also including a serrated portion adjacent to said grasping tip.

12. The forceps according to claim 11 wherein:

said first end is not more than 11 centimeters from said aperture.

13. The forceps according to claim 11 wherein:

said first end is approximately 16.5 centimeters from said aperture.

14. The forceps according to claim 11 wherein:

said v-shaped grasping tips terminate in a sharp edge.

15. The forceps according to claim 11 wherein:

said v-shaped grasping tips terminate in a rounded edge having a radius of curvature of about 500 micrometers.

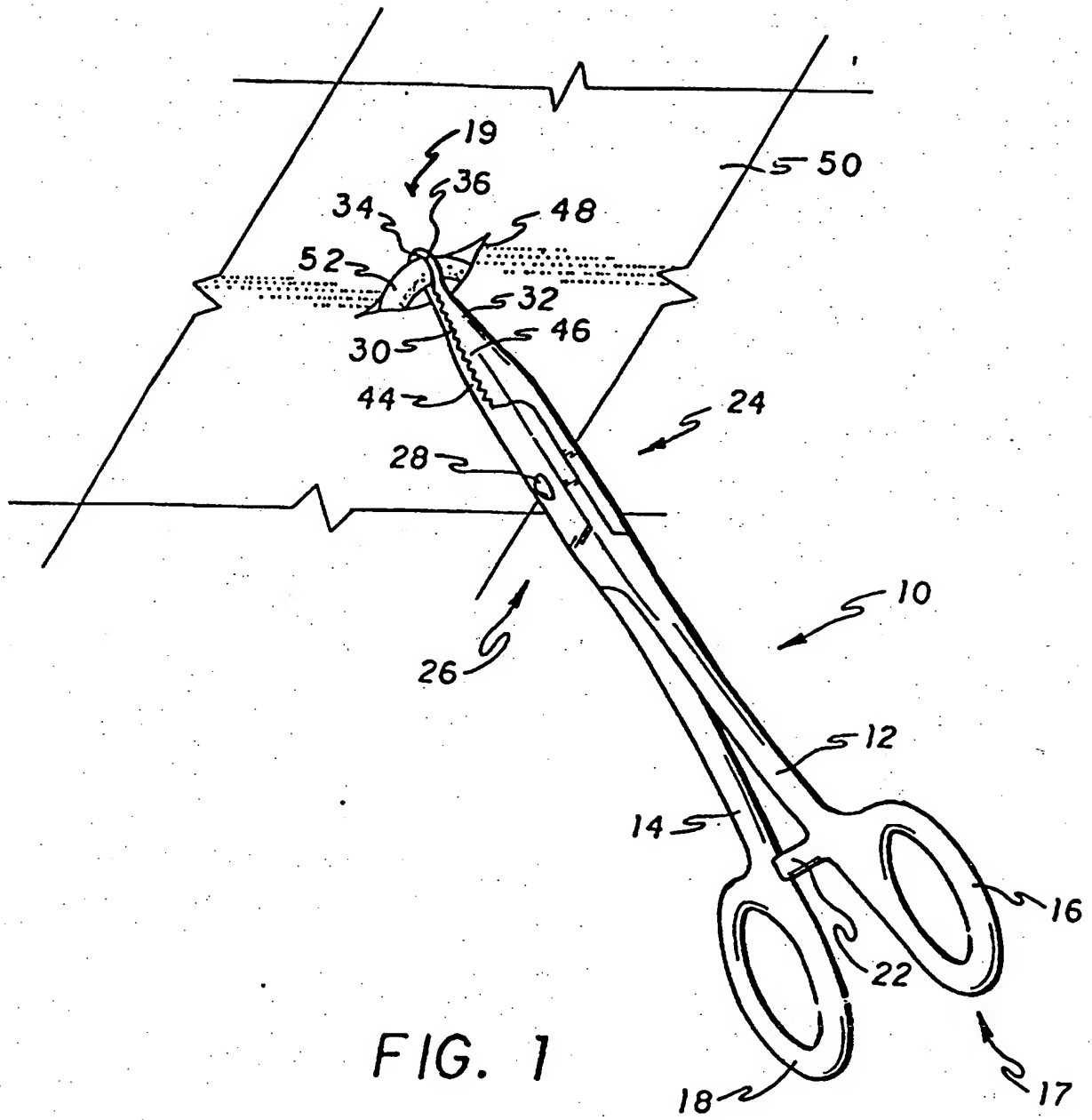


FIG. 1

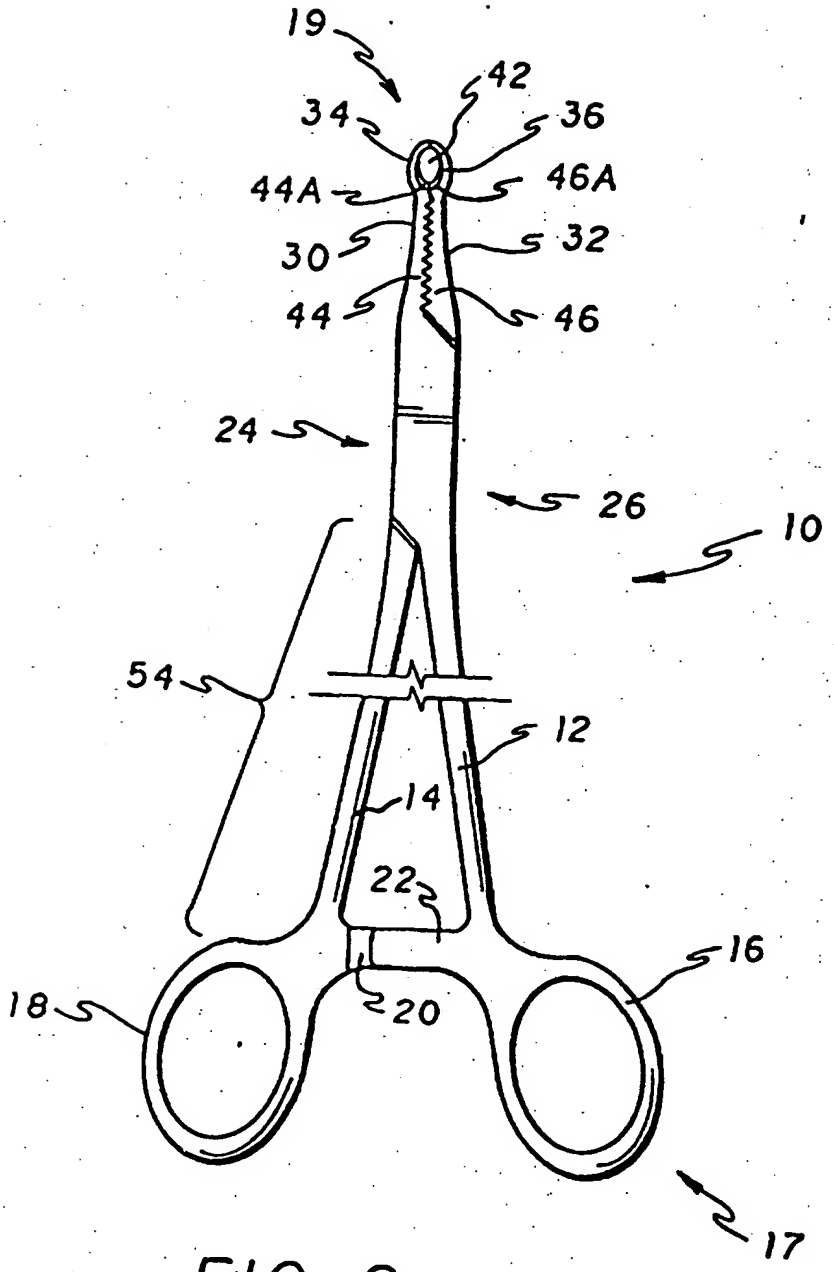


FIG. 2

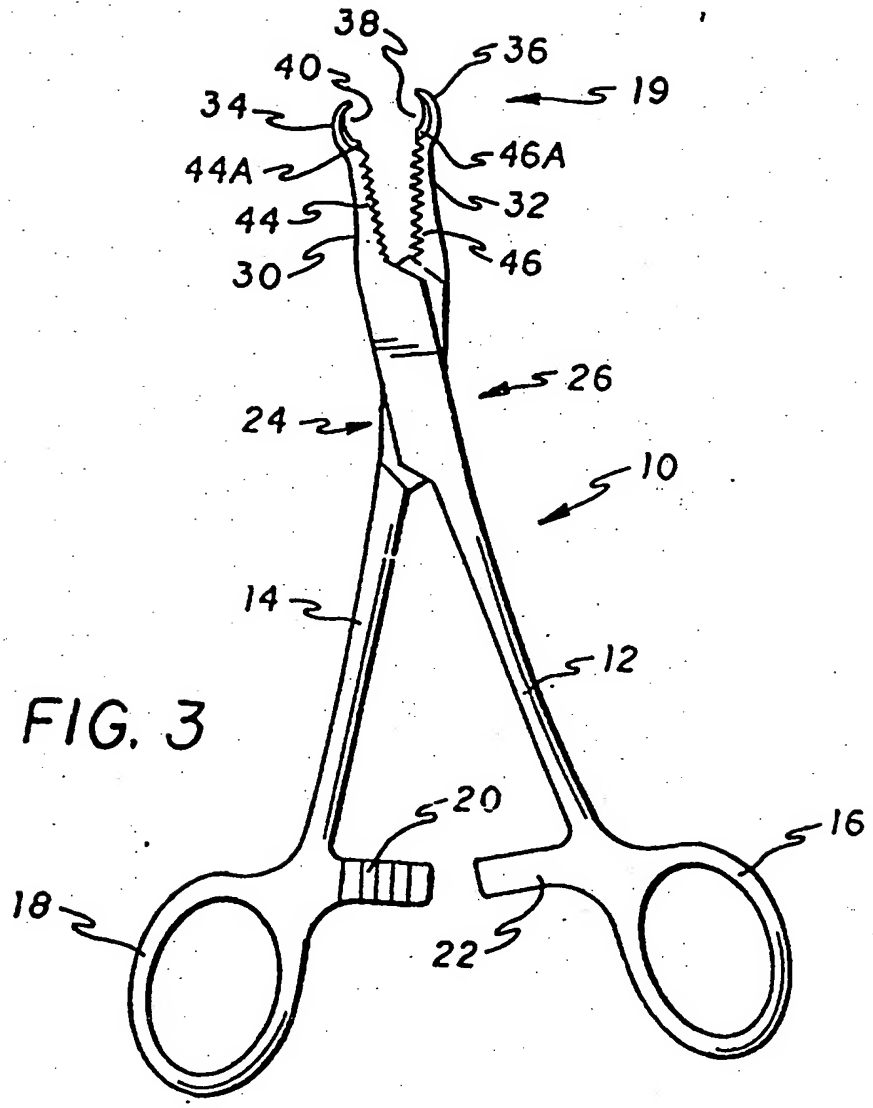


FIG. 3

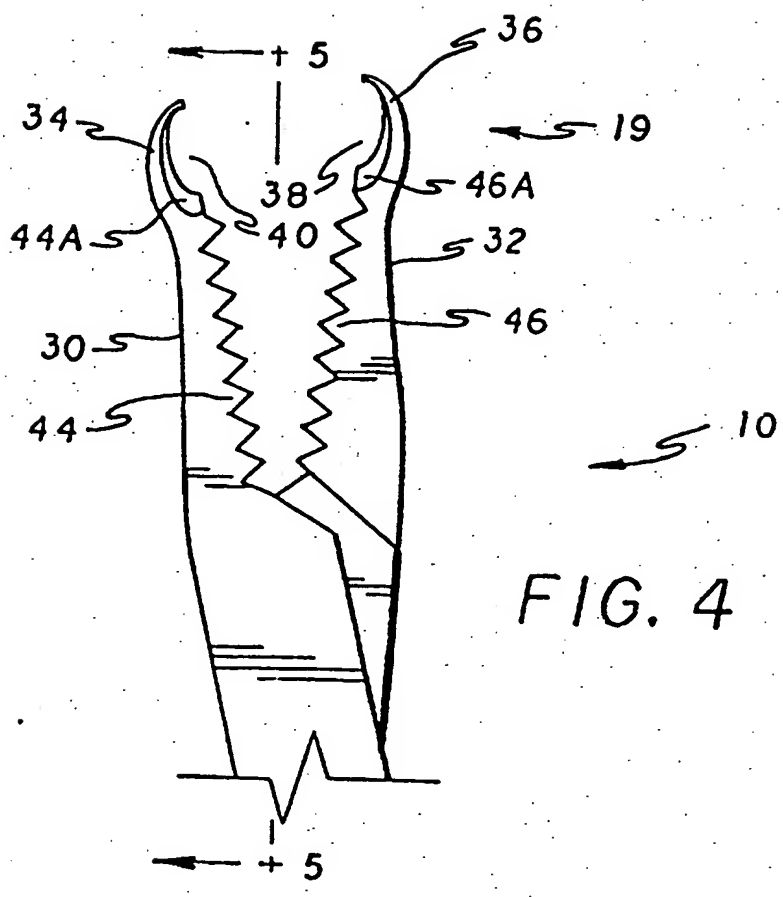


FIG. 4

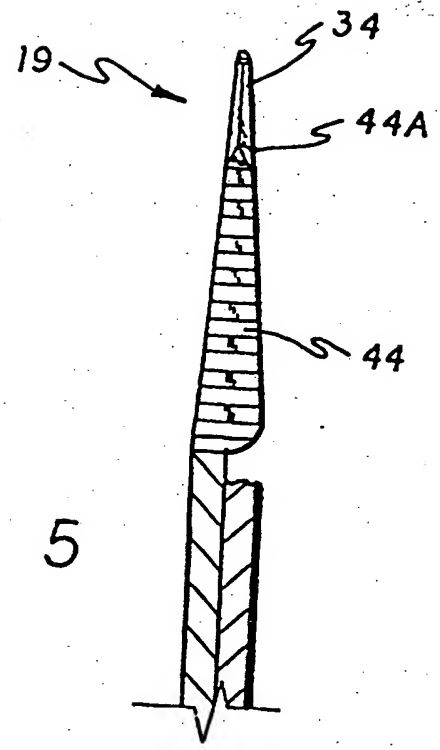


FIG. 5

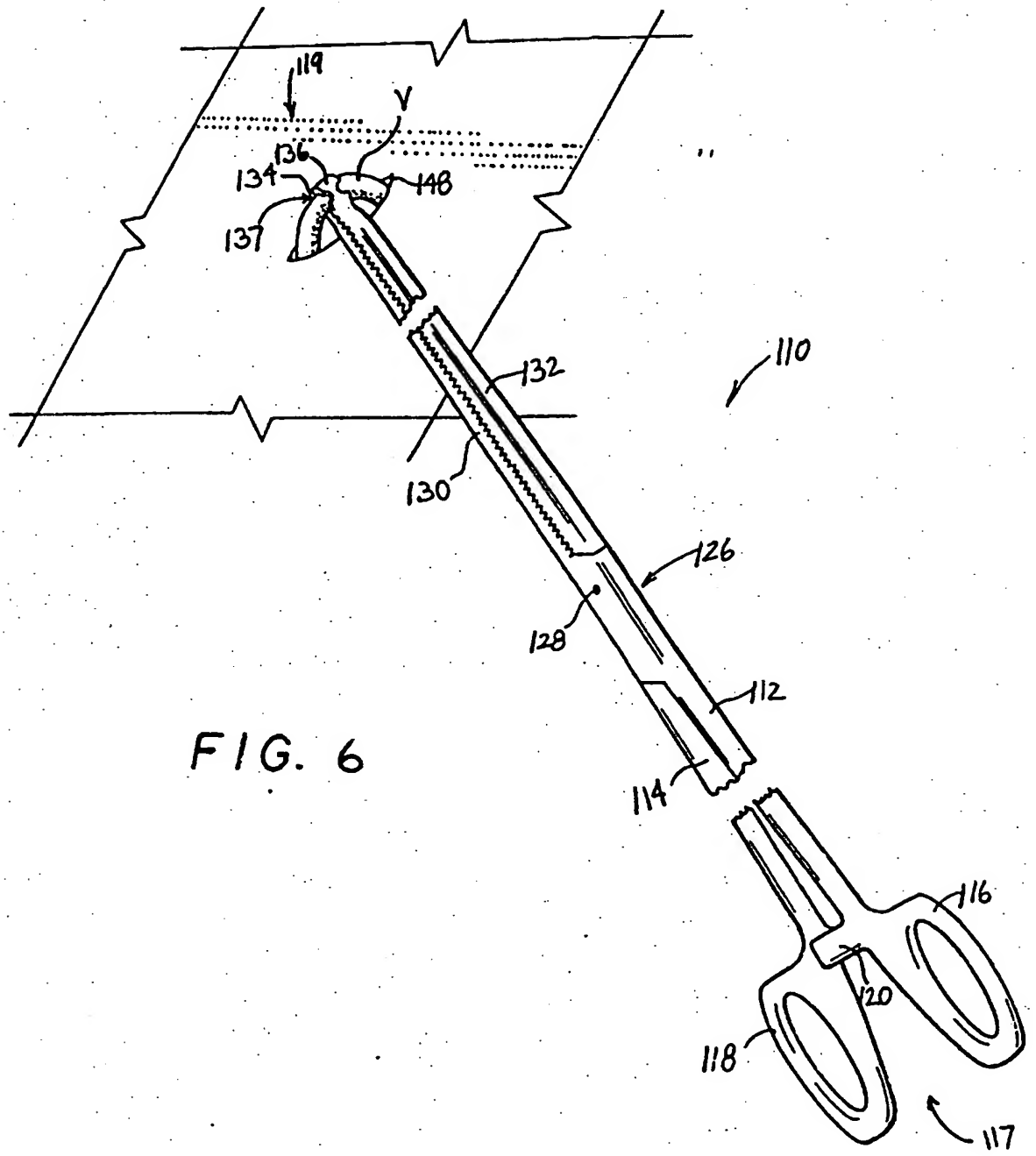
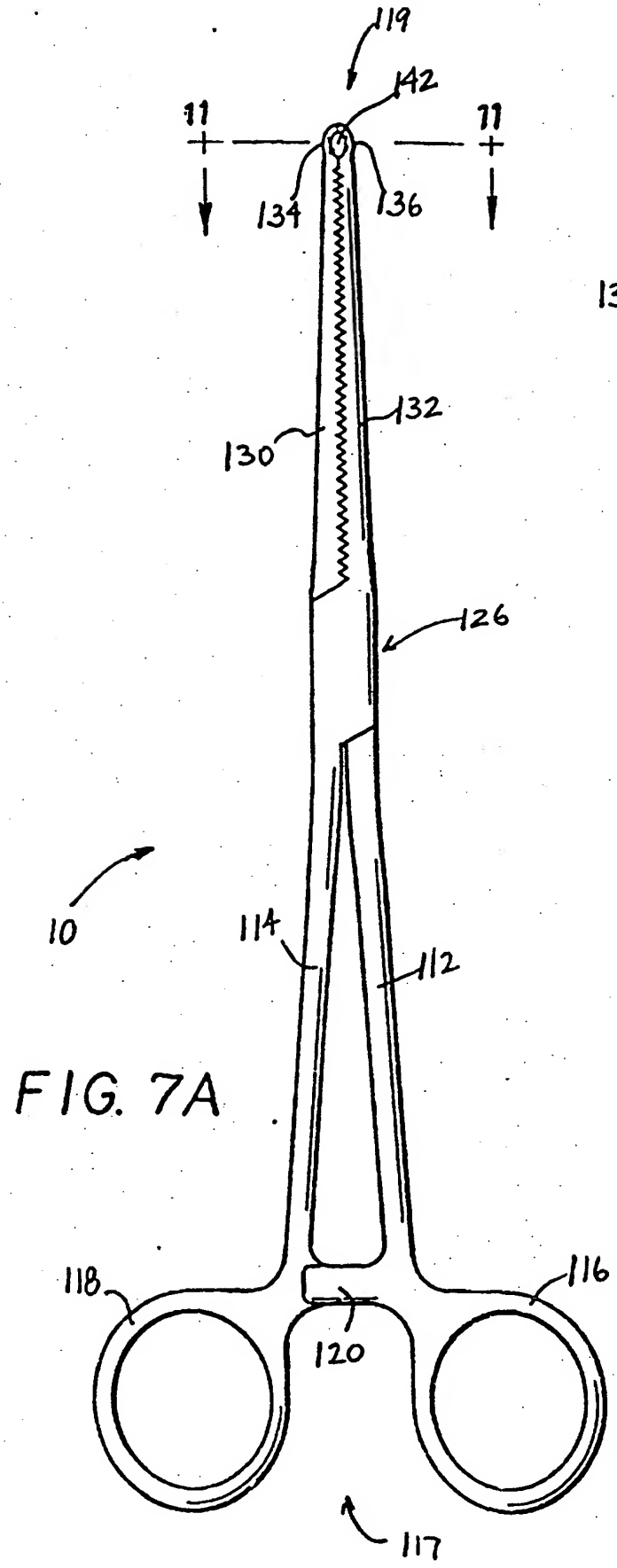


FIG. 6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142
11
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134
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114
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117

FIG. 7A

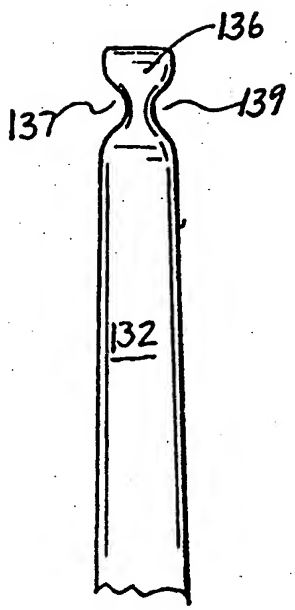
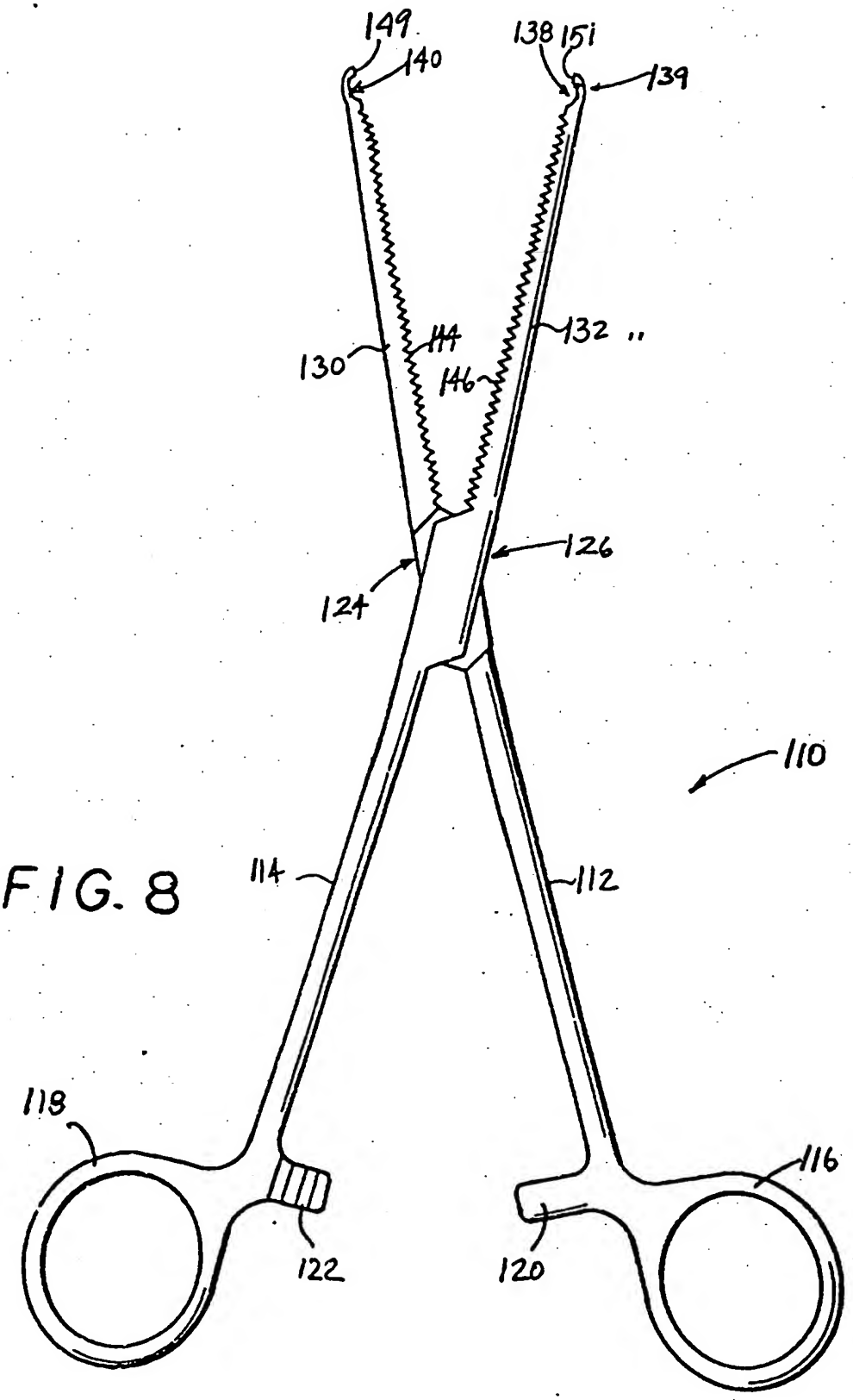

136
137
139
132

FIG. 7B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132
146
126
124
110
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116
122
120

FIG. 8

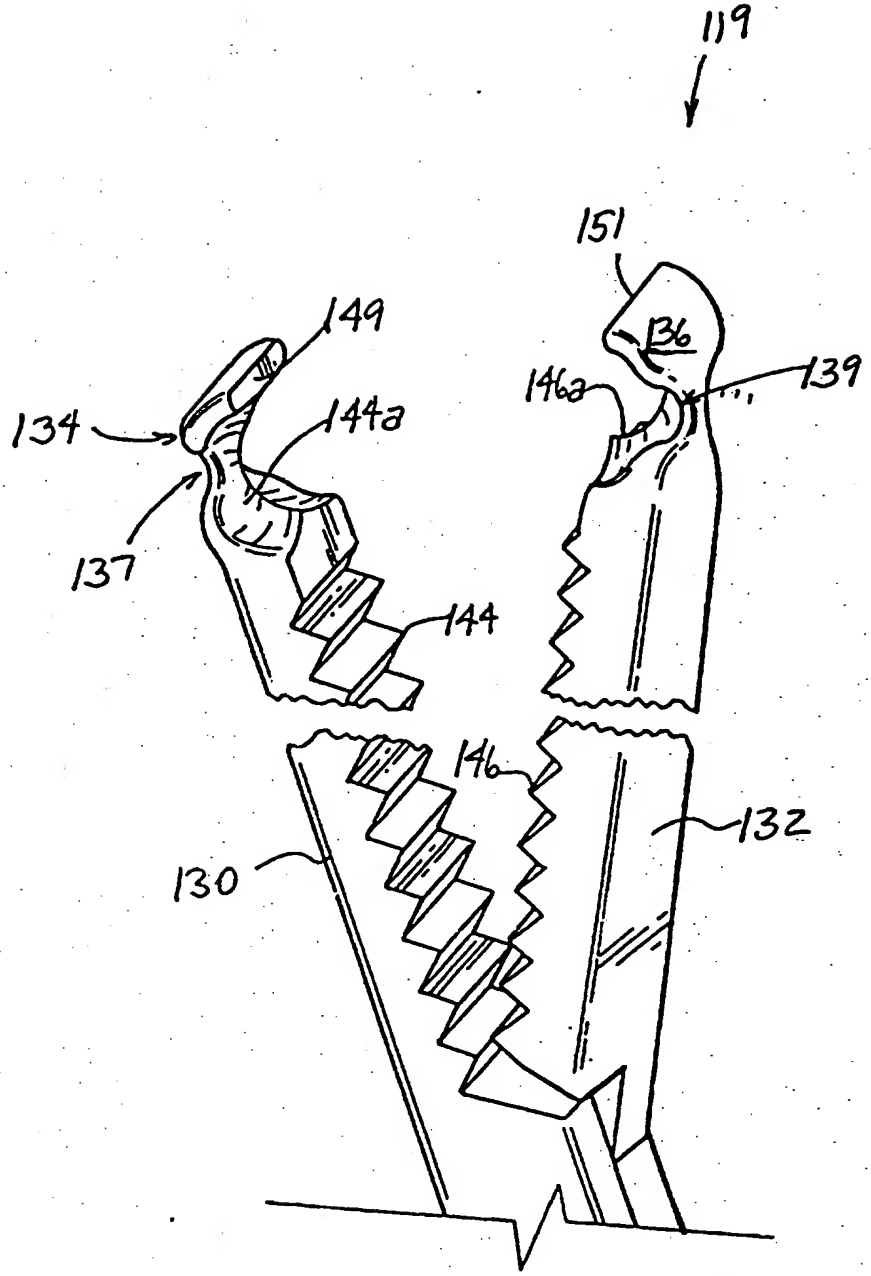


FIG. 9

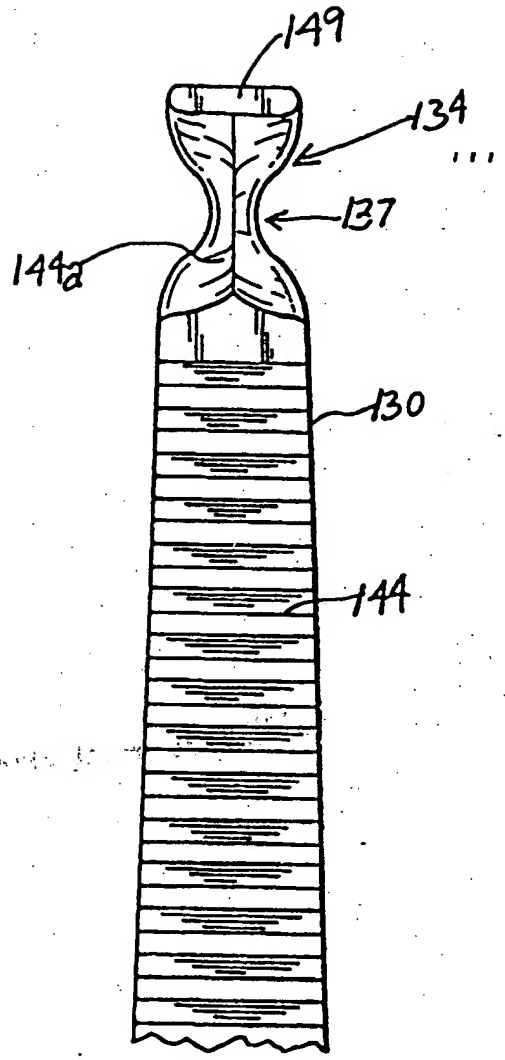
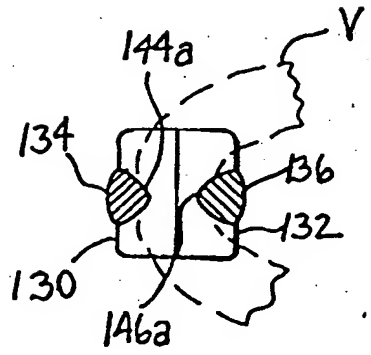


FIG. 10

FIG. 11



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